Patent claims

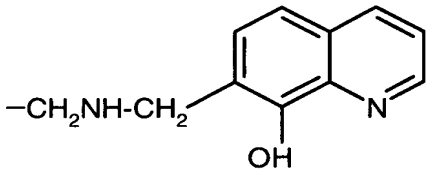
1. A method for producing ion exchangers which comprise not only carboxyl groups but also $-(CH_2)_mNR_1R_2$ groups, characterized in that

   a) monomer droplets of a mixture of a monovinyl aromatic compound, a polyvinyl aromatic compound, a (meth)acrylic compound, an initiator or an initiator combination and also if appropriate a porogen are reacted to form a crosslinked bead polymer,

   b) the resultant bead polymer is functionalized using chelating groups and in this step the copolymerized (meth)acrylic compounds are reacted to form (meth)acrylic acid groups and

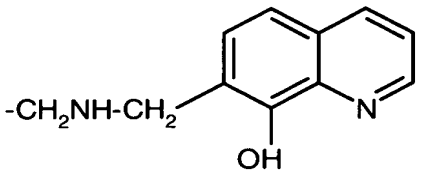
   m is an integer from 1 to 4,

   R_1 is hydrogen or a radical CH_2-$COOR_3$ or $CH_2P(O)(OR_3)_2$ or $-CH_2$-S-CH_2COOR_3 or $-CH_2$-S-C_1-C_4-alkyl or $-CH_2$-S-$CH_2CH(NH_2)COOR_3$ or



   or its derivatives or $C=S(NH_2)$,

   R_2 is a radical CH_2COOR_3 or $CH_2P(O)(OR_3)_2$ or $-CH_2$-S-CH_2COOR_3 or $-CH_2$-S-C_1C_4-alkyl or $-CH_2$-S-$CH_2CH(NH_2)COOR_3$ or



   or its derivatives or $C=S(NH_2)$ and

   R_3 is H or Na or K.

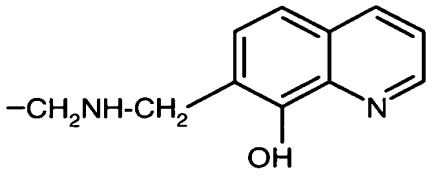
2. An ion exchanger which comprises not only carboxyl groups but also $-(CH_2)_mNR_1R_2$ groups obtainable by

   a) reacting monomer droplets of a mixture of a monovinyl aromatic compound, a polyvinyl aromatic compound, a (meth)acrylic compound, an initiator or an initiator combination and also if appropriate a porogen to give a crosslinked bead polymer,

b) functionalizing the resultant bead polymer using chelating groups and in this step reacting the copolymerized (meth)acrylic compounds to form (meth)acrylic acid groups, where

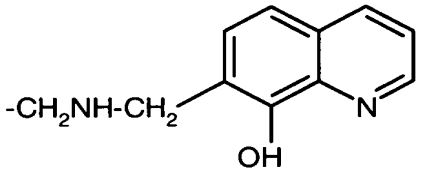
m is an integer from 1 to 4,

R_1 is hydrogen or a radical CH_2-$COOR_3$ or $CH_2P(O)(OR_3)_2$ or -CH_2-S-CH_2COOR_3 or -CH_2-S-C_1-C_4-alkyl or -CH_2-S-$CH_2CH(NH_2)COOR_3$ or



or its derivatives or $C=S(NH_2)$,

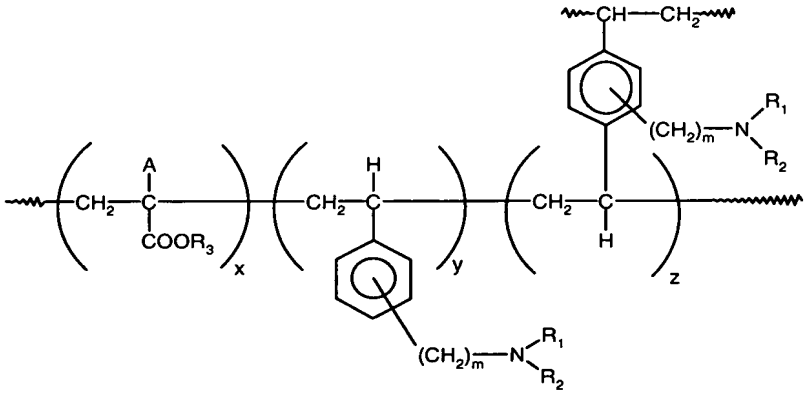
R_2 is a radical CH_2COOR_3 or $CH_2P(O)(OR_3)_2$ or -CH_2-S-CH_2COOR_3 or -CH_2-S-C_1C_4-alkyl or -CH_2-S-$CH_2CH(NH_2)COOR_3$ or



or its derivatives or $C=S(NH_2)$ and

R_3 is H or Na or K.

3. The carboxyl -containing and also -$(CH_2)_mNR_1R_2$ group-containing ion exchanger obtainable as claimed in claim 2, characterized in that it has the composition according to the general formula (I)



(I)

where

x = 0.01 - 0.3,

y = 0.7 - 0.99,

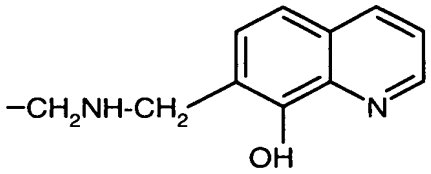
z = 0.01 - 0.2,

m is an integer between 1 and 4,

A is H or C_1-C_4-alkyl, preferably CH_3,

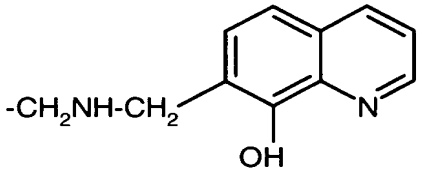
R_3 is H or Na or K,

R_1 is hydrogen or a radical CH_2-$COOR_3$ or $CH_2P(O)(OR_3)_2$ or -CH_2-S-CH_2COOR_3 or -CH_2-S-C_1-C_4-alkyl or -CH_2-S-$CH_2CH(NH_2)COOR_3$ or



or its derivatives or $C=S(NH_2)$ and

R_2 is a radical CH_2COOR_3 or $CH_2P(O)(OR_3)_2$ or -CH_2-S-CH_2COOR_3 or -CH_2-S-C_1C_4-alkyl or -CH_2-S-$CH_2CH(NH_2)COOR_3$ or



or its derivatives or $C=S(NH_2)$.

4. The use of the carboxyl -containing and $-(CH_2)_mNR_1R_2$ group-containing ion exchanger as claimed in either claim 2 or 3 for the adsorption of metals, in particular heavy metals and noble metals, and their compounds from aqueous solutions and organic liquids, for removing heavy metals or noble metals from aqueous solutions, in particular from aqueous solutions of alkaline earth metals or alkali metals, from brines of chloralkali electrolysis, from aqueous hydrochloric acids, from wastewaters or flue gas scrubbers, or else from liquid or gaseous hydrocarbons, carboxylic acids, natural gases, natural gas condensates, petroleums or halogenated hydrocarbons or for removing alkaline earth metals from brines as are customarily used in chloralkali electrolysis, and also for removing heavy metals, in particular iron, cadmium or lead from substances which are reacted during an electrolytic treatment.

5. The use as claimed in claim 4, characterized in that the heavy metals or noble metals adsorbed are mercury, iron, cobalt, nickel, copper, zinc, lead, cadmium, manganese, uranium, vanadium, elements of the platinum group, and also gold or silver.

6. The use as claimed in claim 4, characterized in that metals which can be present in the oxidation state +III are removed from sulfuric acid solutions of copper.

7. The use as claimed in claim 4, characterized in that rhodium or elements of the platinum group and also gold, silver or rhodium or noble metal-containing catalyst residues are removed from organic solutions or solvents.

8. A method for producing an iron exchanger loaded with iron oxide/iron oxyhydroxide having not only carboxyl groups but also $-(CH_2)_mNR_1R_2$ groups, characterized in that

A´) a bead-type chelate-exchange resin having carboxyl groups and $-(CH_2)_mNR_1R_2$ groups as claimed in claim 2 or 3 is brought into contact with iron(III) salts in aqueous suspension,

B´) the suspension obtained from stage A´) is set to pHs in the range from 3 to 10 by adding alkali metal hydroxides or alkaline earth metal hydroxides and the resultant iron oxide/iron oxyhydroxide-comprising chelate-exchange resin being isolated by known methods.

9. An iron oxide/iron oxyhydroxide-loaded ion exchanger which comprises not only carboxyl groups but also $-(CH_2)_mNR_1R_2$ groups which is obtainable by

a) reacting monomer droplets of a mixture of a monovinyl aromatic compound, a polyvinyl aromatic compound, a (meth)acrylic compound, an initiator or an initiator combination and also if appropriate a porogen to give a crosslinked bead polymer,

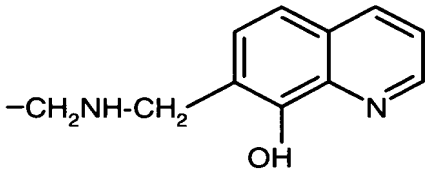
b) functionalizing the resultant bead polymer using chelating groups and in this step reacting the copolymerized (meth)acrylic compounds to form (meth)acrylic acid groups,

A´) contacting the bead-type ion exchanger which bears carboxyl groups and $-(CH_2)_mNR_1R_2$ groups with iron(III) salts in aqueous suspension,

B´) setting the suspension obtained from the stage A´) to pHs in the range from 3 to 10 by adding alkali metal hydroxides or alkaline earth metal hydroxides and isolating the resultant iron oxide/iron oxyhydroxide-loaded chelate-exchange resin by known methods, where

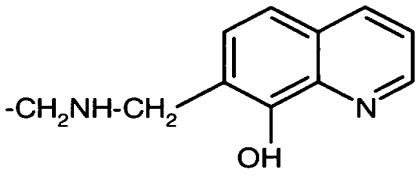
m is an integer from 1 to 4,

R_1 is hydrogen or a radical CH_2-$COOR_3$ or $CH_2P(O)(OR_3)_2$ or -CH_2-S-CH_2COOR_3 or -CH_2-S-C_1-C_4-alkyl or -CH_2-S-$CH_2CH(NH_2)COOR_3$ or



or its derivatives or $C=S(NH_2)$,

R_2 is a radical CH_2COOR_3 or $CH_2P(O)(OR_3)_2$ or -CH_2-S-CH_2COOR_3 or -CH_2-S-C_1C_4-alkyl or -CH_2-S-$CH_2CH(NH_2)COOR_3$ or



or its derivatives or $C=S(NH_2)$ and

R_3 is H or Na or K.

10. The use of the iron oxide/iron oxyhydroxide-loaded chelate-exchange resin produced as claimed in claim 9 for the adsorption of heavy metals, preferably arsenic, cobalt, nickel, lead, zinc, cadmium, copper.